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OVERVIEW OF ISO 13232 – TEST AND ANALYSIS PROCEDURES FOR RESEARCH EVALUATION OF RIDER CRASH PROTECTIVE DEVICES FITTED TO MOTORCYCLES

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TOPICS

1) Background

2) Some applications of ISO 13232

3) Structure of ISO 13232

4) Highlights of ISO 13232

5) Summary

1) BACKGROUND

1970-1985: Investigators worldwide had done experimental research on:

- **Various prototype devices fitted to motorcycles**
- **Intended to protect riders in crashes**
- **Examples included:**

• Accessory bars	1971
• Revised heavy crash duty bars	1973
• Airbags	1973
• Side protection frames	1975
• Experimental Safety Motorcycle	1976
• Crash bar with EA seat	1976
• Hard leg protector	1985
• Soft leg protectors	1985
• Crushable leg protectors	1985
• UKDS type leg protectors	1989

1) BACKGROUND (CONT'D)

- Each investigator used different test and analysis methods. For example:
  - Various indicators of "injury potential"
    - Head
      - trajectory (higher/lower)
      - velocity
      - accelerations
    - Leg
      - Forces and moments
      - Crushable honeycomb with rigid backing plate
      - Breakable bones
  - Various impact configurations (speeds, angles, contact points)

1) BACKGROUND (CONT'D)

- Various modified car and aircraft dummies, mostly incompatible with motorcycles in terms of:
  - Seating position
  - Helmet retention
  - Hand grip
  - Posture
  - Exposure to impacts
  - Others

- As a result, when evaluating similar protective devices, researchers reached very different conclusions, depending on which methodology they used

1) BACKGROUND (CONT'D)

1991: "Leg Protector Seminar" was held in Chantilly, for members of the UN/ECE, EU, US and other administrations, to discuss the test data, merits and risks of "UKDS Motorcycle Leg Protectors"

- **The Chairman/Moderator concluded that:**
  - **There was almost no agreement among researchers**
  - **A common methodology for motorcycle impact research was needed**
  - **UN/WP29/GRSG and ISO should establish a common methodology for MC crash research:**
    - **Based on existing evaluation technologies**
    - **Which subsequently could be used to evaluate prototype devices**

1) BACKGROUND (CONT'D)

1992:

- **UN/ECE/TRANS/WP29 asked ISO to develop a common methodology during the next 18 months**

- **ISO/TC22/SC22/WG22 was formed**
  - **Delegates from 10 nations, including active researchers**
  - **Held intensive series of meetings over 18 months**
  - **Drafted an 8-part "research standard" (400 pages)**

1994: Draft submitted to SC22

1996: ISO 13232 approved by ISO at worldwide level

2005: ISO 13232-Revision 1 approved at worldwide level

2) SOME APPLICATIONS OF ISO 13232

1996: Grose et al, 1996: MC airbag prototype (only a portion of ISO 13232 was used)

1996, 1998: Rogers et al, UKDS leg protectors

1998, 2001, 2005: Iijima et al, Honda prototype airbags

2001: Osendorfer: BMW C1 “safety frame” two-wheeled vehicle

3) STRUCTURE OF ISO 13232

Part 1: Definitions, symbols, and general considerations
Part 2: Definition of impact conditions in relation to accident data
Part 3: Motorcyclist anthropometric impact dummy
Part 4: Variables to be measured, instrumentation, and measurement procedures
Part 5: Injury indices and risk/benefit analysis
Part 6: Full-scale impact test procedures
Part 7: Standardized procedures for performing computer simulations of motorcycle impact tests
Part 8: Documentation and reports

4) HIGHLIGHTS OF ISO 13232

Part 1: Definitions

"feasibility" Capacity of a protective device to reduce injuries to a given body region, and to reduce injury costs in a significant percentage of the accident population, without increasing injury costs in more than a very small percentage for the accident population

i.e., a feasible device is one which has a small injury "risk-to-benefit percentage"

4) HIGHLIGHTS OF ISO 13232

Part 2: Definition of impact conditions in relation to accident data

- Coded impact and injury data for 501 accidents from LA and Hannover

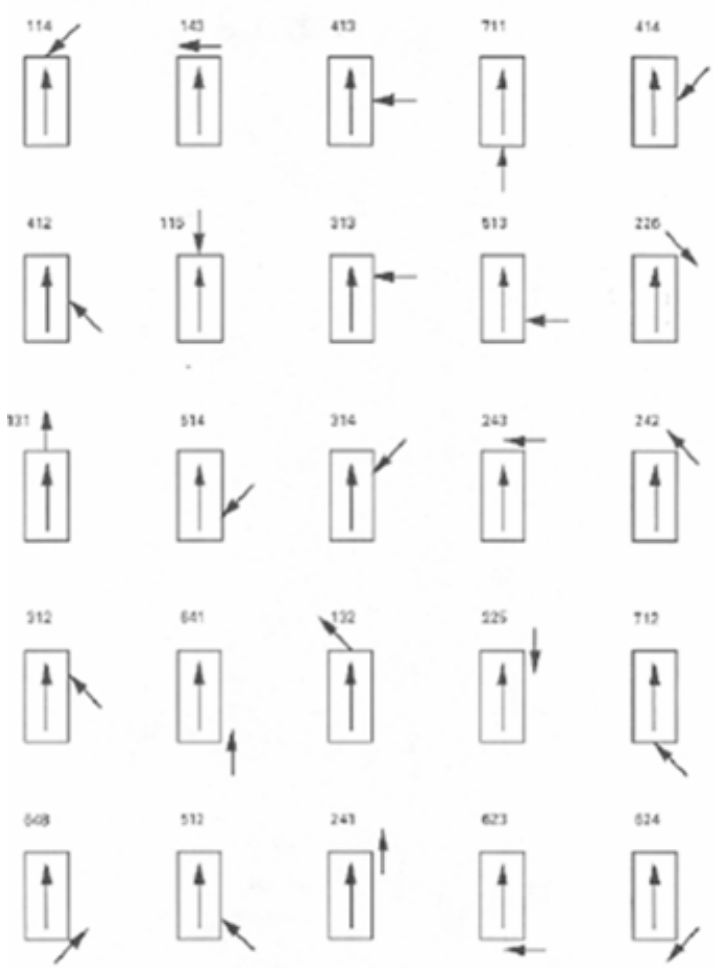
Table C.2 — Los Angeles data

Ref no	OV tp	MC sp	OV ap	MC sp	RHA deg	H	No inj	MAIS	Injuries BR	T	AIS						
1	FC	S	8	10	10	y	2	1	11	2	1	11	1	1			
2	RO	F	15	30	0	y	3	3	11	2	1	10	1	1	8	4	3
3	FC	S	10	35	35	y	3	3	9	5	3	8	1	1	12	1	1
4	SF	F	0	14	90	y	2	1	9	1	1	10	1	1			
5	FO	S	15	15	100	n		1									
6	SR	F	20	28	150	n	1	1	4	1	1						
7	FO	S	0	35	110	y	1	3	11	5	3						
8	RO	S	10	17	75	y	1	1	10	1	1						
9	SF	F	5	15	100	y	2	1	10	1	1	10	1	1			
10	RC	F	99	25	20	n		3									
12	SM	S	33	28	10	n	3	1	4	1	1	4	1	1	8	1	1

4) HIGHLIGHTS OF ISO 13232

Part 2: Definition of impact conditions in relation to accident data (cont'd)

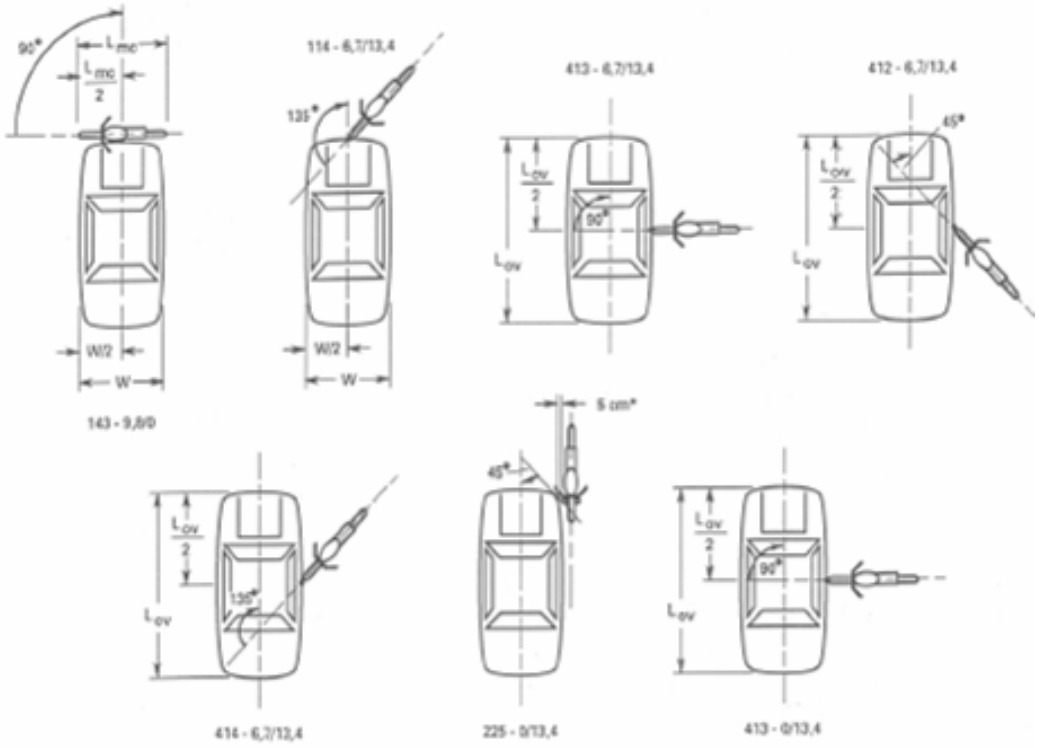
- "Frequencies of occurrence" for 200 "impact configurations" (used for "calibrated computer simulations" and "risk-benefit analysis" of protective devices)



4) HIGHLIGHTS OF ISO 13232

Part 2: Definition of impact conditions in relation to accident data (cont'd)

- "7 full-scale test" impact configurations (used for "preliminary evaluation" of a device and in order "to calibrate computer simulations")



4) HIGHLIGHTS OF ISO 13232

Parts 3, 4 and 6: Impact dummy, measurements, test procedures

ISO Motorcycle Anthropometric Test Device (MATD): 28 standardized modifications to Hybrid III sit/stand car test dummy

4) HIGHLIGHTS OF ISO 13232

Part 5: Injury indices and risk-benefit analysis

- "Normalized injury cost" model, based on dummy measurements (flow diagram)

4) HIGHLIGHTS OF ISO 13232

Part 5: Injury indices and risk-benefit analysis

- **Risk-benefit analysis**

Comparison of results to reference risk and benefit values

NOTE This Annex provides potentially useful information for users of ISO 13232 regarding risk and benefit results. However, this information is provided only as a suggested reference guideline, and users may elect to develop other guidelines or have no particular guideline, depending on the nature of the research.

For IC_{norm}, compare the values calculated in 5.9.4.1 to 5.9.4.4 to the following reference values:

1) ideally, the percentage of accidents which are beneficial should be greater than the percentage which indicate no effect, which should be greater than the percentage which are harmful,

2) the risk/benefit percentage should be less than seven percent and should not be more than 12 percent[2)],

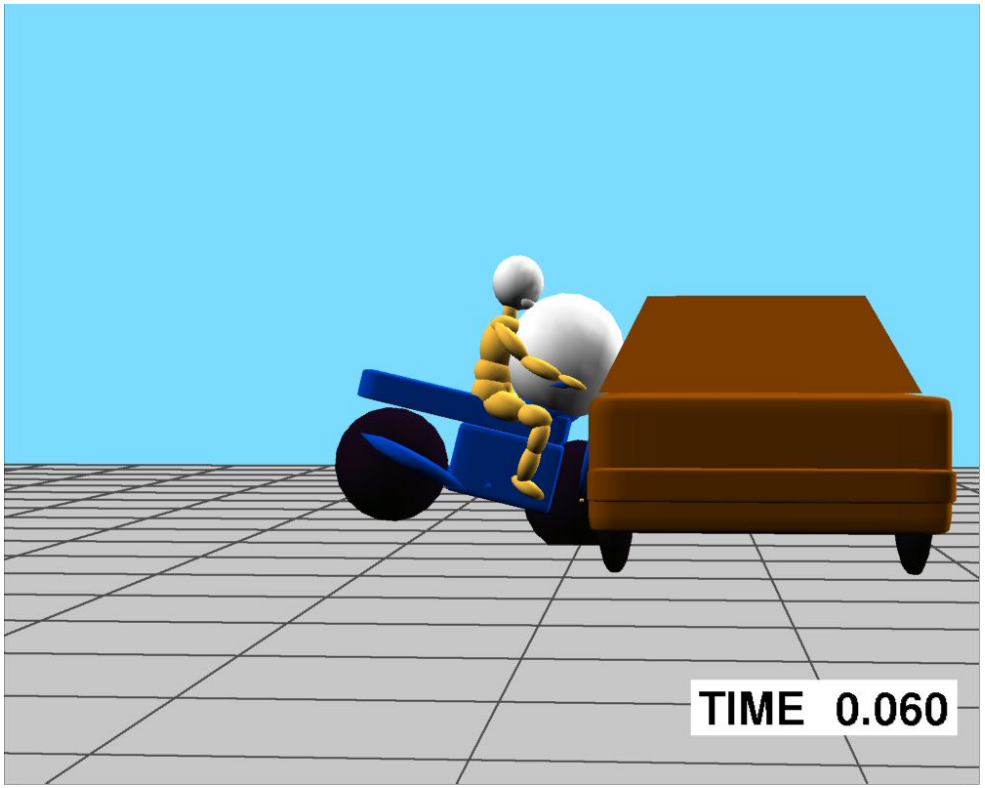
3) the average net benefit should be greater than zero, and

4) the average benefit per beneficial case should be greater than the average risk per harmful case.

4) HIGHLIGHTS OF ISO 13232

Part 7: Standardized procedures for performing computer simulations of motorcycle impact tests

- **Requirements for:**
  - **Modeling**
  - **Parameters**
  - **Outputs**
  - **Post-processing (animations, injury analysis, R-B)**
  - **Calibration against test data (31 lab tests, 14 full-scale crash tests)**



Early example of airbag simulation, c. 1992

5) SUMMARY

ISO 13232:

- Provides a "common methodology" for research evaluation of potential rider crash protective devices fitted to motorcycles
- Addresses many of the significant limitations of earlier research methods
- Is the first example of such a standard in the motor vehicle field
- Provides objective indices and guidelines for evaluating protective device "feasibility"

5) SUMMARY (CONT'D)

ISO 13232:

- Recently has been applied to evaluation of leg protectors, airbags and safety frames
- May be further updated/extended in the future in order to provide:
  - Methods for evaluating potentially harmful effects of unintended deployment of airbags
  - Other impact configurations (e.g., single vehicle; larger opposing vehicles; 2up riding; etc)
  - Other body regions (e.g., shoulder, upper extremities, pelvis, etc)
- Is intended for use by all researchers doing work in this field